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(54) OPTICAL FIBER ARRAY, PARTS FOR ARRAYING THE SAME AND PRODUCTION OF OPTICAL FIBER ARRAY

(57)Abstract:

PURPOSE: To provide the optical fiber array which does not require the use of X-axis and Y-axis optical stages at the time of aligning polarization planes by rotating the polarization plane-maintaining optical fibers, the parts for arraying the optical fiber array and the process for production of the optical fiber array.

CONSTITUTION: A guide 20 for optical fibers is fixed onto a upper plane part 18 of a V-groove base plate 10.

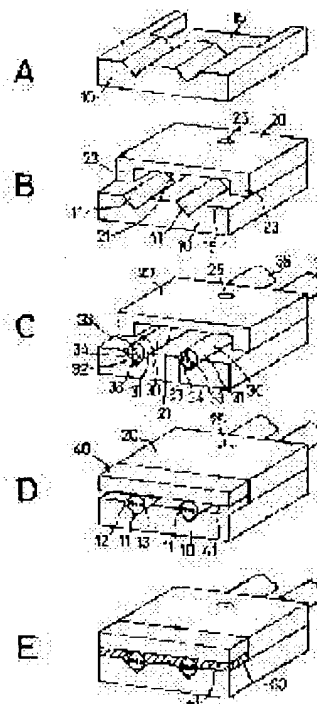
The polarization plane-maintaining optical fibers 30 are then inserted into the V-groove base plate 10 from behind and optical fiber exposed parts 31 are placed in

the V-grooves 11. The polarization planes of the polarization plane-maintaining optical fibers 30 are

aligned by rotating the polarization plane-maintaining optical fibers 30 with the space between the V-groove base plate 10 and the rear surface 21

of the guide 20 for the optical fibers as a guide for rotation of the optical fibers in the state of placing the optical fiber exposed parts 31 in the V-grooves 11. An optical fiber-retaining base

plate 40 is thereafter provided on the optical fiber exposed parts 31 and the polarization



plane-maintaining optical fibers 30 are fixed by a resin type adhesive 60.

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CLAIMS

[Claim(s)]

[Claim 1] The optical fiber array to which even the V groove substrate with which the V groove was formed, the optical fiber laid in said V groove, and the optical fiber prepared on said optical fiber are characterized by the inferior surface of tongue preparing the crowning of said optical fiber, and the predetermined guide for spacing detached building ***** on said V groove substrate in the optical fiber array which fixed in [a member] one.

[Claim 2] The components for optical fiber array alignment with which the inferior surface of tongue is characterized by to have further the guide for optical fibers with which it is prepared on the crowning of said optical fiber, and a predetermined spacing detached building ***** V groove substrate in the V groove substrate with which the V groove in which an optical fiber is laid was formed, and the components for optical fiber array alignment with which even the optical fiber prepared on said optical fiber in order to hold said optical fiber to said V groove is equipped with a member.

[Claim 3] the V groove substrate with which the V groove in which a plane-of-polarization preservation optical fiber is laid was formed, and spacing ***** the crowning of said plane-of-polarization preservation optical fiber and predetermined in the inferior surface of tongue -- the manufacture approach of the optical fiber array characterized by to have the process which performs plane-of-polarization doubling of said plane-of-polarization preservation optical fiber, and the process which fix said plane-of-polarization preservation optical fiber to said V groove after that by considering as a guide said inferior surface of tongue of the guide for optical fibers prepared on said V groove substrate like, and the space between **s.

[Claim 4] The manufacture approach of an optical fiber array that even an optical fiber prepares a member on said plane-of-polarization preservation optical fiber, and said plane-of-polarization preservation optical fiber is characterized by fixing said plane-of-polarization preservation optical fiber to said V groove in the manufacture approach of an optical fiber array according to claim 3 after even said optical fiber has touched the 3rd page of the inferior surface of tongue of a member, and the both-sides side of said V groove.

[Claim 5] the V groove substrate with which the V groove in which an optical fiber is laid was formed, and spacing ***** the crowning of said optical fiber and predetermined in the inferior surface of tongue -- the manufacture approach of the optical fiber array characterized by to have the process which performs insertion to said V groove of said optical fiber, and the process which fixes said optical fiber to said V groove after that by considering said inferior surface of tongue of the guide for optical fibers prepared for said V Mizogami like, and space between **s as a guide.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the manufacture approach of the optical fiber array which aligned and fixed two or more optical fibers, its component for alignment, and an optical fiber array.

[0002]

[Description of the Prior Art] In various fields, such as a communication link which used the optical fiber, and measurement, the plane-of-polarization preservation optical fiber is used. This plane-of-polarization preservation optical fiber has the property that the plane of polarization of propagation light can be saved, and the application to the various sensors using the polarization and phase characteristic of light, the application to a coherent communication link, etc. are made.

[0003] Since two or more predetermined estranges this plane-of-polarization preservation optical fiber spacing every, it is made to arrange and it fixes in one as an optical fiber array, the various components for alignment are used. And when doing in this way and connecting two or more plane-of-polarization preservation optical fiber arrays which aligned with other optics, it is necessary to hold the plane of polarization of two or more plane-of-polarization preservation optical fibers to the desired angular position, respectively.

[0004] For this reason, holding two or more plane-of-polarization preservation optical fibers to the desired angular position conventionally, respectively, as it is shown in drawing 3, predetermined made it estrange spacing every mutually, and it was made to align.

[0005] That is, you make it the plane-of-polarization preservation optical fiber 30 first, located above the V groove substrate 10 so that the optical fiber outcrop 31 which the covering part 39 made of resin of the plane-of-polarization preservation optical fiber 30 exposed from the covering part 39 made of resin on the crevice 15 of the V groove substrate 10 by removing the covering part 39 made of resin of the plane-of-polarization preservation optical fiber 30 may be located on V groove 11, respectively as shown in drawing 3 A.

[0006] Next, by moving the plane-of-polarization preservation optical fiber 30 to the X shaft orientations 70 and the Y shaft orientations 80 using an optical stage (not shown), as shown in drawing 3 B, where alignment of the optical fiber outcrop 31 is carried out into V groove 11, the plane-of-polarization preservation optical fiber 30 is rotated, and plane-of-polarization doubling of the plane-of-polarization preservation optical fiber 30 is performed.

[0007] Then, as shown in drawing 3 C, even an optical fiber forms a substrate 50 on the optical fiber outcrop 31.

[0008] Next, the resin system adhesives 60 are made to flow, the resin system adhesives 60 are stiffened by heating, UV irradiation, etc., and even the plane-of-polarization preservation optical fiber 30, the V groove substrate 10, and an optical fiber make a substrate 50 fix in one from the adhesives inlet 55 where even the optical fiber was formed in the substrate 50, as shown in drawing 3 D.

[0009] Then, when even the plane-of-polarization preservation optical fiber 30, the V groove substrate

10, and optical fiber which fixed in one grind the front end section of a substrate 50, edge figuring of the plane-of-polarization preservation optical fiber 30 is performed.

[0010] In addition, since the plane of polarization of light is saved, the stress grant section 33 is formed in the both sides of a core 34, and the optical fiber outcrop 31 is being fixed to the plane-of-polarization preservation optical fiber 30 after even the side faces 12 and 13 and optical fiber of V groove 11 have touched the 3rd page of the inferior surface of tongue 51 of a substrate 50.

[0011]

[Problem(s) to be Solved by the Invention] However, it sets to such a conventional approach. Even if few per each plane-of-polarization preservation optical fiber 30, two sets of optical stages, the X-axis and a Y-axis, are needed, respectively (depending on the case). In order to adjust the gate of the X-axis and Y-axis both directions, therefore two more sets of optical stages are needed, respectively, a twice as many optical stage as the number of the hearts of the plane-of-polarization preservation optical fiber 30 used for an optical fiber array is needed at least. Since such an optical stage was expensive, it had the problem that the fixture which assembles an optical fiber array will become very expensive as the number of the hearts of the plane-of-polarization preservation optical fiber 30 increased.

[0012] Furthermore, the optical stage of the X-axis and a Y-axis had to be operated at least every plane-of-polarization preservation optical fiber 30, and the alignment using such an optical stage also had the problem of taking time amount very much.

[0013] Moreover, when spacing (namely, pitch of V groove 11) of the adjoining plane-of-polarization preservation optical fiber 30 was made small with several 100 micrometers and the number of the hearts of the plane-of-polarization preservation optical fiber 30 was eight or more, there was a problem even of it even becoming impossible for it to become impossible to already secure the arrangement tooth space of an optical stage, and to assemble an optical fiber array depending on the conventional approach.

[0014] furthermore -- moreover, even if it was the case where not a plane-of-polarization preservation optical fiber but the usual optical fiber which has not prepared the stress grant section was used as an optical fiber, the special fixture for them needed to be used for laying these optical fibers into a V groove, and there was also a problem of also taking time amount.

[0015] Therefore, in case a one division target of this invention rotates a plane-of-polarization preservation optical fiber and performs plane-of-polarization doubling, he is to offer the manufacture approach of the optical fiber array which does not need to use the optical stage of the X-axis and a Y-axis, its component for alignment, and an optical fiber array.

[0016] Other purposes of this invention are to offer the manufacture approach of the optical fiber array which can lay an optical fiber easily into a V groove, its component for alignment, and an optical fiber array.

[0017]

[Means for Solving the Problem] According to this invention, the optical fiber array characterized even for the V groove substrate with which the V groove was formed, the optical fiber laid in said V groove, and the optical fiber prepared on said optical fiber by the inferior surface of tongue preparing the crowning of said optical fiber and the predetermined guide for spacing detached building ***** on said V groove substrate in the optical fiber array which fixed in [a member] one is obtained.

[0018] Moreover, the components for optical fiber array alignment with which the inferior surface of tongue is characterized by to have further the guide for optical fibers with which it is prepared on the crowning of said optical fiber and a predetermined spacing detached building ***** V groove substrate are obtained in the components for optical fiber array alignment with which even the V groove substrate with which the V groove in which an optical fiber is laid was formed according to this invention, and the optical fiber prepared on said optical fiber in order to hold said optical fiber to said V groove are equipped with a member.

[0019] Furthermore, moreover, the V groove substrate with which the V groove in which a plane-of-polarization preservation optical fiber is laid was formed according to this invention, spacing ***** the crowning of said plane-of-polarization preservation optical fiber and predetermined in the inferior surface of tongue -- with said inferior surface of tongue of the guide for optical fibers prepared on said V

groove substrate like The manufacture approach of the optical fiber array characterized by having the process which performs plane-of-polarization doubling of said plane-of-polarization preservation optical fiber, and the process which fixes said plane-of-polarization preservation optical fiber to said V groove after that is acquired by considering space between ** as a guide. In this case, preferably, even an optical fiber prepares a member on said plane-of-polarization preservation optical fiber, and said plane-of-polarization preservation optical fiber is in the condition to which even said optical fiber touched the 3rd page of the inferior surface of tongue of a member, and the both-sides side of said V groove, and fixes said plane-of-polarization preservation optical fiber to said V groove.

[0020] The V groove substrate with which the V groove in which an optical fiber is laid was formed further again according to this invention, spacing ***** the crowning of said optical fiber and predetermined in the inferior surface of tongue -- with said inferior surface of tongue of the guide for optical fibers prepared for said V Mizogami like The manufacture approach of the optical fiber array characterized by having the process which performs insertion to said V groove of said optical fiber, and the process which fixes said optical fiber to said V groove after that is acquired by considering space between ** as a guide.

[0021]

[Function] In this invention, when the inferior surface of tongue prepares the crowning of an optical fiber, and the predetermined guide for spacing detached building ***** on a V groove substrate Or by having the guide for optical fibers with which the inferior surface of tongue is prepared on the crowning of an optical fiber, and a predetermined spacing ***** V groove substrate Or the V groove substrate with which the V groove in which a plane-of-polarization preservation optical fiber is laid was formed, spacing ***** the crowning of a plane-of-polarization preservation optical fiber and predetermined in the inferior surface of tongue -- by performing plane-of-polarization doubling of a plane-of-polarization preservation optical fiber by considering the inferior surface of tongue of the guide for optical fibers prepared on the V groove substrate like, and space between **s as a guide The guide for optical fibers can be used now as a guide for rotation of an optical fiber, and in case a plane-of-polarization preservation optical fiber is rotated by V Mizouchi and plane-of-polarization doubling is performed, it becomes unnecessary to use the optical stage of the X-axis and a Y-axis. Therefore, the fixture which assembles an optical fiber array becomes the thing of a low price. Moreover, by it becoming unnecessary performing alignment using the optical stage which requires time amount, assembly time amount is shortened and a manufacturing cost is reduced. Furthermore, since it becomes unnecessary to use the optical stage of the X-axis and a Y-axis for every optical fiber, it becomes unnecessary to secure the arrangement tooth space between these optical stages therefore, and the limit to the number of the hearts of the optical fiber in which an assembly is possible is also lost.

[0022] Moreover, in this invention, when the inferior surface of tongue prepares the crowning of an optical fiber, and the predetermined guide for spacing detached building ***** on a V groove substrate Or by having the guide for optical fibers with which the inferior surface of tongue is prepared on the crowning of an optical fiber, and a predetermined spacing ***** V groove substrate or the V groove substrate with which the V groove in which an optical fiber is laid was formed and spacing ***** the crowning of an optical fiber and predetermined in the inferior surface of tongue -- with the inferior surface of tongue of the guide for optical fibers prepared on the V groove substrate like By performing insertion to the V groove of an optical fiber by considering space between ** as a guide The guide for optical fibers can be used now as a guide for insertion of an optical fiber, and alignment of the optical fiber can be easily carried out into a V groove, consequently the manufacturing cost of an optical fiber array is reduced.

[0023] In addition, spacing of the inferior surface of tongue of the guide for optical fibers and the crowning of an optical fiber is 5 micrometers or more, and, as for the guide for optical fibers, it is desirable to be designed so that spacing of the inferior surface of tongue of the guide for optical fibers and the Kamitaira surface part of a V groove substrate in which the V groove was formed may become below an optical numerical aperture. If spacing of the inferior surface of tongue of the guide for optical fibers and the crowning of an optical fiber is smaller than 5 micrometers, while it will become difficult

to insert an optical fiber in the space between a V groove substrate and the guide for optical fibers, the problem that the end face of an optical fiber also becomes easy to be missing is also produced. Moreover, it is because an optical fiber can come now out of a V groove, so it becomes impossible to give V Mizouchi the guidance about an optical fiber certainly if spacing of the inferior surface of tongue of the guide for optical fibers and the Kamitaira surface part of a V groove substrate in which the V groove was formed is larger than an optical numerical aperture.

[0024] Moreover, more preferably, it is designed so that spacing of the inferior surface of tongue of the guide for optical fibers and the crowning of an optical fiber may become about [of an optical numerical aperture] $1/2$. For example, this spacing is designed by about 50 micrometers when the single mode optical fiber for a communication link with a diameter of 125 micrometers is used as an optical fiber. It is because **** of the optical fiber at the time of rotation of a plane-of-polarization preservation optical fiber also decreases while insertion of the optical fiber to the space between a V groove substrate and the inferior surface of tongue of the guide for optical fibers becomes easy.

[0025] Furthermore, it is designed so that spacing of the inferior surface of tongue of the guide for optical fibers and the Kamitaira surface part of a V groove substrate in which the V groove was formed may become about [of an optical numerical aperture] $1/2$ again more preferably. For example, the spacing is designed by about 50 micrometers when an optical fiber with a diameter of 125 micrometers is used. If spacing of the inferior surface of tongue of the guide for optical fibers and the Kamitaira surface part of a V groove substrate in which the V groove was formed exceeds about [of an optical numerical aperture] $1/2$ In case an optical fiber falls, while an optical fiber rotates, in order to fall, a twist arises in an optical fiber. It is because an optical fiber turns so that a spring may be extended and the direction of polarization of the stress grant section of the optical fiber after manufacture, i.e., the direction of an optical fiber, shifts, in case it pastes up with the post heating hardening resin etc.

[0026]

[Example] Next, it explains with reference to the drawing of attachment of the example of this invention.

[0027] As shown in drawing 1 A, two or more V grooves 11 are mutually formed in the Kamitaira surface part 18 of the V groove substrate 10 in parallel. It is open for free passage to two or more of these V grooves 11, and the crevice 15 for inserting the covering part 39 made of resin of the plane-of-polarization preservation optical fiber 30 is established in the V groove substrate 10.

[0028] Next, as shown in drawing 1 B, the guide 20 for optical fibers is fixed on the Kamitaira surface part 18 of the V groove substrate 10. This fixing is performed by fixing with adhesives the base of the leg 23 established in the both ends of the guide 20 for optical fibers on the both ends of the Kamitaira surface part 18 of the V groove substrate 10.

[0029] Next, as shown in drawing 1 C, the plane-of-polarization preservation optical fiber 30 is inserted from the back of the V groove substrate 10, and the optical fiber outcrop 31 exposed from the covering part 39 made of resin is laid on V groove 11 by removing the covering part 39 made of resin of the plane-of-polarization preservation optical fiber 30. At this time, it is made mostly in agreement [the front end side of the plane-of-polarization preservation optical fiber 30] with the front end side of the V groove substrate 10, and it holds the covering part 39 made of resin of the plane-of-polarization preservation optical fiber 30 in the space between the crevice 15 of the V groove substrate 10, and the inferior surface of tongue 21 of the guide 20 for optical fibers.

[0030] Drawing 2 is drawing which looked at drawing 1 C from the front, formed spacing a between the inferior surface of tongue 21 of the guide 20 for optical fibers, and the crowning 35 of the optical fiber outcrop 31 of the plane-of-polarization preservation optical fiber 30, and has formed spacing b between the inferior surface of tongue 21 of the guide 20 for optical fibers, and the Kamitaira surface part 18 of the V groove substrate 10. The plane-of-polarization preservation optical fiber 30 used in this example consists of an external clad 32 and a core 34 of a core, and the diameter of the optical fiber outcrop 31, i.e., the diameter of a clad 32, is 125 micrometers. In this example, spacing a was set to 50 micrometers and spacing b was set to 113 micrometers. In addition, since the plane of polarization of light is saved at the plane-of-polarization preservation optical fiber 30, the stress grant section 33 is formed in the both

sides of a core 34.

[0031] Next, if drawing 1 C is referred to again, where the optical fiber outcrop 31 of the plane-of-polarization preservation optical fiber 30 is laid on V groove 11, the plane-of-polarization preservation optical fiber 30 will be rotated by considering space between the V groove substrate 10 and the inferior surface of tongue 21 of the guide 20 for optical fibers as a guide, and plane-of-polarization doubling will be performed according to the angular position of a request of the plane of polarization of the plane-of-polarization preservation optical fiber 30.

[0032] In this case, since the guide 20 for optical fibers is formed on the V groove substrate 10, during rotation of the plane-of-polarization preservation optical fiber 30, the plane-of-polarization preservation optical fiber 30 does not secede from V groove 11, and is positioned by the position to the side faces 12 and 13 of V groove 11. Therefore, even if it does not use the optical stage of the X-axis and a Y-axis, the plane-of-polarization preservation optical fiber 30 can be rotated, and plane-of-polarization doubling can be performed easily.

[0033] Then, as shown in drawing 1 D, even an optical fiber forms a substrate 40 on the optical fiber outcrop 31. In this case, the front end section of a substrate 40 was made mostly in agreement [even an optical fiber] with the front end side of the plane-of-polarization preservation optical fiber 30, and the front end side of the V groove substrate 10.

[0034] Next, the resin system adhesives 60 are made to flow from the adhesives inlet 25 formed in the guide 20 for optical fibers, as shown in drawing 1 E. The resin system adhesives 60 are made to harden the resin system adhesives 60 with heating using heat-curing mold resin, and even the plane-of-polarization preservation optical fiber 30, the V groove substrate 10, the guide 20 for optical fibers, and an optical fiber make a substrate 40 fix in one. In addition, as resin system adhesives 60, when ultraviolet curing mold resin is used, ultraviolet rays are made to irradiate and the resin system adhesives 60 are stiffened.

[0035] Then, when even the plane-of-polarization preservation optical fiber 30, the V groove substrate 10, and optical fiber which fixed in one grind the front end section of a substrate 40, an optical fiber array is assembled by performing edge figuring of the plane-of-polarization preservation optical fiber 30.

[0036] Thus, in the assembled optical fiber array, the optical fiber outcrop 31 is being fixed, after even the side faces 12 and 13 and optical fiber of V groove 11 have touched the 3rd page of the inferior surface of tongue 41 of a substrate 40.

[0037] In addition, although the plane-of-polarization preservation optical fiber was used as an optical fiber in this example, the manufacture approach of the optical fiber array of this invention, its component for alignment, and an optical fiber array can be applied also to the optical fiber with which the stress grant section is not prepared, and can lay an optical fiber in V groove 11 easily also in such a case, using the space between the inferior surfaces of tongue 21 of the V groove substrate 10 and the guide 20 for optical fibers as a guide for insertion of an optical fiber.

[0038]

[Effect of the Invention] In this invention, when the inferior surface of tongue prepares the crowning of an optical fiber, and the predetermined guide for spacing detached building ***** on a V groove substrate Or by having the guide for optical fibers with which the inferior surface of tongue is prepared on the crowning of an optical fiber, and a predetermined spacing ***** V groove substrate Or the V groove substrate with which the V groove in which a plane-of-polarization preservation optical fiber is laid was formed, spacing ***** the crowning of a plane-of-polarization preservation optical fiber and predetermined in the inferior surface of tongue -- by performing plane-of-polarization doubling of a plane-of-polarization preservation optical fiber by considering the inferior surface of tongue of the guide for optical fibers prepared on the V groove substrate like, and space between **s as a guide The guide for optical fibers can be used now as a guide for rotation of an optical fiber, and in case a plane-of-polarization preservation optical fiber is rotated by V Mizouchi and plane-of-polarization doubling is performed, it becomes unnecessary to use the optical stage of the X-axis and a Y-axis. Therefore, the fixture which assembles an optical fiber array becomes the thing of a low price. Moreover, by it

becoming unnecessary performing alignment using the optical stage which requires time amount, assembly time amount is shortened and a manufacturing cost is reduced. Furthermore, since it becomes unnecessary to use the optical stage of the X-axis and a Y-axis for every optical fiber, it becomes unnecessary to secure the arrangement tooth space between these optical stages therefore, and the limit to the number of the hearts of the optical fiber in which an assembly is possible is also lost.

[0039] Moreover, in this invention, when the inferior surface of tongue prepares the crowning of an optical fiber, and the predetermined guide for spacing detached building ***** on a V groove substrate Or by having the guide for optical fibers with which the inferior surface of tongue is prepared on the crowning of an optical fiber, and a predetermined spacing ***** V groove substrate or the V groove substrate with which the V groove in which an optical fiber is laid was formed and spacing ***** the crowning of an optical fiber and predetermined in the inferior surface of tongue -- with the inferior surface of tongue of the guide for optical fibers prepared on the V groove substrate like By performing insertion to the V groove of an optical fiber by considering space between ** as a guide The guide for optical fibers can be used now as a guide for insertion of an optical fiber, and alignment of the optical fiber can be easily carried out into a V groove, consequently the manufacturing cost of an optical fiber array is reduced.

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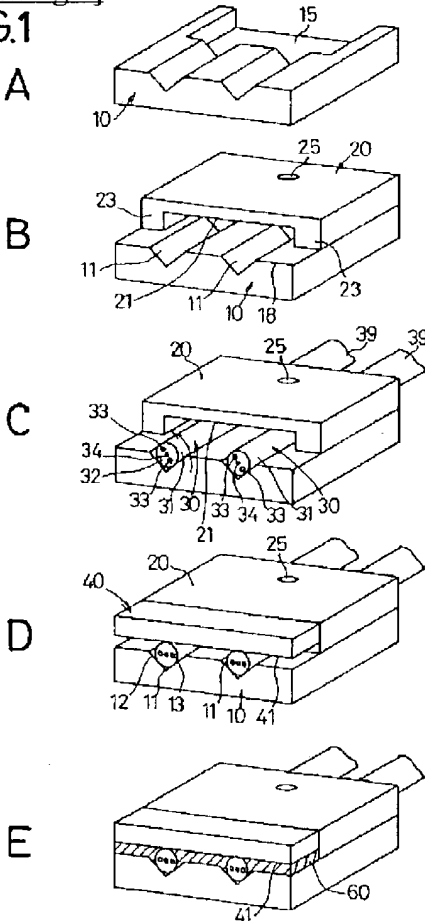
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DRAWINGS

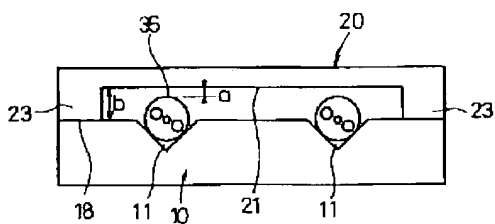
[Drawing 1]

FIG.1



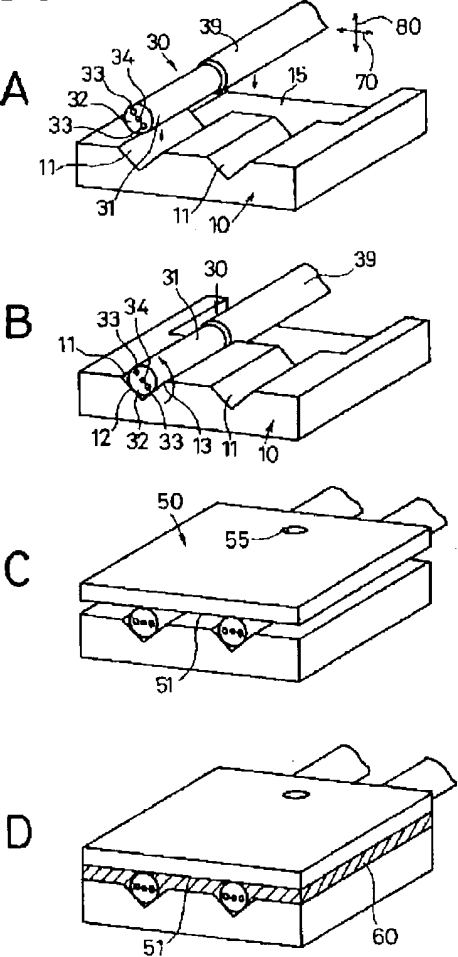
[Drawing 2]

FIG.2



[Drawing 3]

FIG.3



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is a perspective view for explaining the example of this invention.

[Drawing 2] It is drawing which looked at drawing 1 C from before.

[Drawing 3] It is a perspective view for explaining the conventional technique.

[Description of Notations]

- 10 -- V groove substrate
- 11 -- V groove
- 12 -- Side face
- 13 -- Side face
- 15 -- Crevice
- 18 -- Kamitaira surface part
- 20 -- Guide for optical fibers
- 21 -- Inferior surface of tongue
- 25 -- Adhesives inlet
- 30 -- Plane-of-polarization preservation optical fiber
- 31 -- Optical fiber outcrop
- 32 -- Clad
- 34 -- Core
- 35 -- Crowning
- 39 -- Covering part made of resin
- 40 -- Even an optical fiber is a substrate.
- 41 -- Inferior surface of tongue
- 60 -- Resin system adhesives
- 70 -- X shaft orientations
- 80 -- Y shaft orientations

[Translation done.]